INTERNATIONAL TSUNAMI INFORMATION CENTER

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISION
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NEWSLETTER

The ITIC Newsletter brings news and information to tsunami researchers, engineers, educators, community protection agencies and governments in 36 countries. We welcome your news, reports, papers, or abstracts.

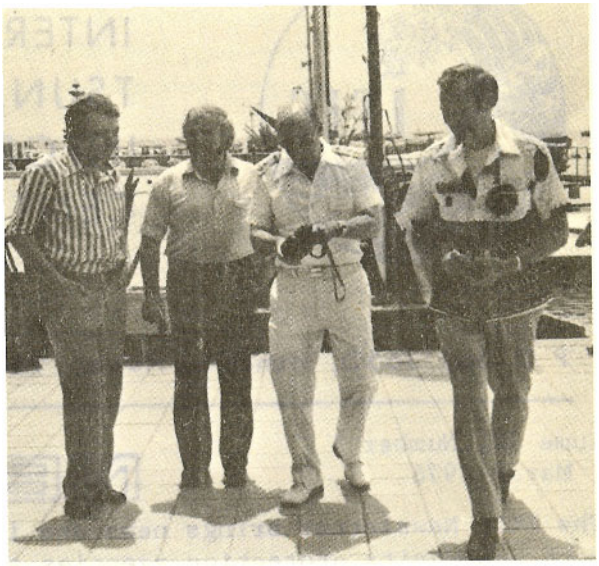
Some of the participants to the V Session of the International Coordination Group for the Tsunami Warning System in the Pacific (ICG!ITSU), at the Instituto Del Mar, Callao, Lima, Peru, February 1976.

V Session of UNESCO-Intergovernmental Oceanographic Commission's ICG/ITSU, Lima, Peru, 23-27 February 1976.

The International Co-ordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU) completed in Lima, Peru its fifth biennial meeting.

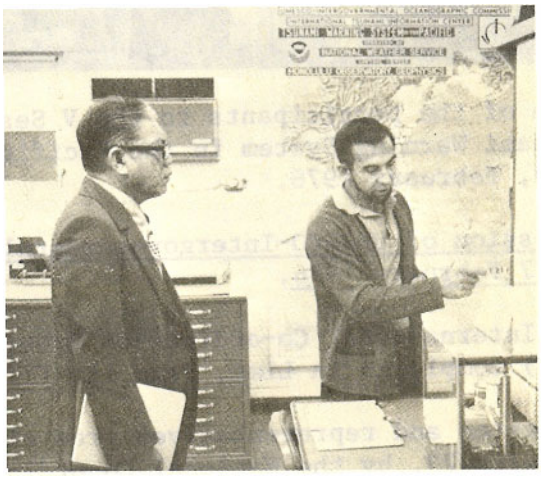
Delegates and representatives from eight member states, and observers were welcomed on February 23, by the National Co-ordinator for Peru, Mr. C. Vargas and by Dr. G. Giermann, Deputy Secretary, representing UNESCO and the Inte1"governmenta1 Oceanographic Commission. The meetings were formally inaugurated by the Secretary of the Peruvian Navy. Aided by the efficient support and outstanding hospitality of the Direccion de Hidrografia y Navegacion de 1a Marina of Peru, and by the Regional Center of Seismological Studies in South America (CERESIS), the sessions reviewed the progress of the Tsunami Warning System over the past two years, and provided guidelines for the future. The report and recommendations of the Director, ITIC, marked the increased international participation in the organization, the developing national and regional Warning Systems, and the automation designed to improve the protection from tsunamis throughout the Pacific.

From left to right: Dr. P. Lagos (Peru), Mr. F. Abba (France), Tte C. Vargas (Peru), Tng. F. Villao (Ecuador), Commodore J. V. Presbitero, Lt. Col. W. Reotutar and Captain R. Valera (Philippines).



From left to right: Dr. G. Giermann (UNESCO-IOC), Dr. G. Pararas-Carayannis (ITIC), Admiral E. Villalobos (Mexico), and Dr. G. Flittner (USA).

Participants to the ICG/ITSU meetings relaxing during a lunch break. In the foreground from left to right: Captain V. Rodriguez (Peru), Dr. Yuri Belyaev (USSR), Adm. E. Villalobos (Mexico), Dr. G. Miller (USA), Ing. C. Arguedas (Peru), Mr. R. Montaner (Chile), and Dr. G. Pararas-Carayannis (ITIC).



Mr. Thomas Sokolowski (right), of ITIC's Honolulu Observatory, explaining operation of observatory equipment to Commodore Jayme Presbitero (left), of the Philippines during a recent visit.

UNESCO/IOC AND UNITED NATIONS REPORTS

The following is a summary of the proceedings and resolutions of the Fifth ICG/ITSU Session:

DRAFT SUMMARY REPORT

1. Opening of the Session: The V Session of the International Coordination Group for the Tsunami Warning System in the Pacific was convened at the Conference Hall, of the Peru Institute of the Sea (Instituto del Mar) Callao - Lima, Peru on Monday, 23 February 1976 at 1015. The Peruvian Navy's Direction of Hydrography and Navigation acted as the host for this Conference, and together with the Regional Center of Seismological Studies in South America (CERESIS), made arrangements for logistical support for the Conference.

The inaugural ceremony marking the opening of the V Session began with welcoming speeches, by the National Coordinator of Peru, Lt. Cesar Vargas F., and by the Peru Secretary of the Navy, Admiral Carlos Garrido Leca Soto, emphasizing the need for international cooperation in the field of tsunamis and the Tsunami Warning System in the Pacific.

Dr. G. Giermann, Deputy Secretary of the IOC of UNESCO, then welcomed the Group in the name of the Director General of UNESCO and the Secretary of the IOC, and thanked the Government of Peru and its Department of the Navy for hosting the Conference and providing their fine facilities.

2. Adoption of the Agenda and Election of a Rapporteur: The opening of the working session was made by the Secretary who noted that Dr. Shigehi Suyehiro, Chairman of ICG/ITSU, had submitted his resignation and that a new chairman ought to be elected before the end of the V Session to succeed him. Dr. Glenn Flittner, Head of the U.S. Delegation, was asked and accepted to serve as temporary chairman for the duration of the Conference. Dr. George Pararas-Carayannis, Director ITIC, accepted to serve as rapporteur. The Chairman expressed, in the name of the Group, his sincere thanks to Dr. Suyehiro for the excellent work he had provided while being in office. He asked the Secretary to transmit these wishes to Dr. Suyehiro. The chairman then with assistance of the Secretary presented minor comments and modifications to the agenda, after which the agenda was adopted.

3. State of Implementation of Res. VII-24 and of Recommendations from the 4th Session of ICG/ITSU, Held in Wellington, New Zealand, February 1974: The Secretary reviewed for the Group the status of Resolution VII-24 and the recommendations of the IV Session of the International Coordination Group for the Tsunami Warning System which met in Wellington, New Zealand, in February of 1974. The Secretary examined Resolution EC-IV.6 approved by the IOC Executive Council in Ottawa, Canada, in June 1974, which deals with the functions of the International Tsunami Information Center. He informed the group that the implementation of the resolution and the recommendations had made considerable progress. The Director of ITIC pointed out that an anomaly existed in the functions of ITIC as stated by the subject resolution which required reexamination and restatement. Furthermore, he mentioned that this anomaly was indicated in his report to the Group (Conference document) and proposed restatement of the functions of ITIC for consideration by the Group. The Group agreed that the functions in their revised form were still unsatisfactory, and recommended that the matter be taken up again as stated in Draft Resolution, DR 6.

4. Consideration of IOC Res. EC-IV.6 Concerning ITSU, Adopted by the 4th Session of the IOC Executive Council, Ottawa, 17-22 June 1974: In relation to resolution EC-IV.6, 8th paragraph, the Director of ITIC informed the session of his contacts with ICSU on the data archival and exchange requirements of the TWS. Specifically, the Director of ITIC reported that contact on this subject has been carried out by correspondence and telephone with the World Data Center-A Tsunamis, at Boulder, Colorado. A visit was then made to ICSU headquarters in Paris, in August 1975 by the Director for the purpose of discussing the ICSU guide. The World Data Center-B, in Moscow, was contacted by correspondence. A plan is being worked out between ITIC and the World Data Center-A Tsunami, for data collection as well as the digitization, storage, and dissemination. A revision of the guide has been recommended to ICSU. Rec. DR 1 was adopted pursuant to the above discussion.

5. Report by the Director, ITIC, Honolulu: The Director of ITIC presented a progress report on activities of the Center and the TWS for the last two years. Specifically he gave background material on the TWS and summarized the ITIC history, objectives and initial functions. He also commented on the functions of the Center.

The Director of ITIC then went on to report on Tsunami Investigations during the period of 1974-1976, on the Tsunami Warning System, automation, on new reporting stations, the ITIC staff and physical facilities, and the implementation of the IV Session of ICG/ITSU resolutions and recommendations. In reviewing the implementation, he commented on the posting of the Associate Director, Mr. Sydney Wigen from Canada, and the need for continuous support of this office by member states. The group agreed fully to this statement and adopted DR 5 on this subject. In discussing ITIC assistance to Developing Countries to establish their own national Tsunami Warning Systems, the Director of ITIC reported on his contacts with UNDP and UNESCO officials and the preparation of a report by ITIC giving background information on the UNDP and guidelines for the preparation and submission of project proposals. The discussion of this matter is reflected under item 6.

Subsequently he discussed ITIC liaison activities, the visiting scientist program, the ITIC Newsletter, and the library. Furthermore, he expanded on his previous report on the compilation of Tsunami Information Data and presented for consideration a series of recommendations. These recommendations contained in the report of the ITIC Director were considered apropos for further discussion and possible adoption. With some minor editorial changes, the recommendations were regrouped in terms of priority and relevancy and were presented in sequence to the Group.Based on extensive discussions, most of the recommendations from the ITIC Director's report were adopted under the relevant agenda items.

The chairman thanked the Director ITIC for the excellent work which he, his associate and his staff have performed over the last two years (DR 4 refers). The group also felt that member states should be invited to send more staff to ITIC or pay money into the IOC trust fund for these purposes (DR 2 refers). They also agreed that some of the trust fund money should be earmarked for further visits of individual scientists and technicians for training purposes to the Center (DR 3 refers).

There was a general understanding that ITIC should continue to collect full information and to recommend topics of tsunami research relating to the Tsunami Warning System. DR 7 was adopted accordingly.

6. National Reports on Current Tsunami Research and Instrumental Development: The representatives of member states reported on latest developments in their respective

countries. National reports were presented by the delegates of Canada, Chile, Ecuador, Peru, Philippines, U.S.A. and U.S.S.R. The Japanese report was acknowledged in the absence of a Japanese representative.

In this connection, the group was informed that four countries of the region (Colombia, Ecuador, Peru and Chile) had decided to submit a regional project to UNDP for assistance in the establishment of their own national warning systems. The request had been prepared with the assistance of the Director ITIC. The Chair encouraged the countries also to submit requests for support to UNDP under each Country's Program. The group stressed the importance of sub-regional efforts of this kind, and, in this connection, agreed to adopt also a recommendation (DR 8) for assistance to developing island states.

7. Consideration of Recommendations from the IUGG Tsunami Committee Meeting Held in Grenoble, France, August 1975: The group regretted the absence due to sickness of Prof. Soloviev, Secretary of the IUGG Tsunami Committee. The group received a brief report from the Director ITIC, and Dr. E. Silgado from CERESIS, on the recommendations adopted at the IUGG Tsunami Committee Meeting, in Grenoble, France, August 1975. None of the recommendations has direct relevance to ITSU activities.

8. Consideration of UNCTAD Resolution 108 (XIV) of 12 September 1974: The Secretary brought to the attention of the Assembly the recent UN concern with the negative effects on natural disasters on developing island countries and the importance of assistance to overcome such natural disasters, and commented on resolution 3202 (S-VI) of the General UN Assembly and Resolution 108 (XIV) of UNCTAD.

In view of the concern of the Republic of Philippines in the development of its tsunami warning capability as expressed by its national report, the Secretary observed that UNESCO, IOC and ITIC can play an important role in assisting the Philippines and many other island countries in the Pacific.

The Secretary reported of the possible availability of funds from the United Nations Environmental Program (UNEP) for early warning planning and preparedness. ITIC is considered qualified to apply for support from UNEP in conducting liaison workshops with member states, particularly island states, for the purpose of planning implementation of regional tsunami warning systems and familiarization with civil preparedness. It was recommended that the proposal contained in rec. DR 8 be elaborated by ITIC.

The Secretary further drew the attention of the group to a draft recommendation of the Intergovernmental Conference on the assessment and mitigation of earthquake risk, held in UNESCO, Paris, 10-19 February 1976. The recommendation which had not yet been finally adopted at the time of the ITSU meeting reads as follows:

"The Conference recommends to the Member States to take the following actions with the assistance of UNESCO and its IOC, UNDRO and UNDP:

1. Improve and to put into operation stable and precise sensors for recording tsunamis in the open sea.

2. Devise and install long-period, broad-band seismographs at seismological stations; to continue and complete the automatic processing of seismic data; to ensure the integration of hydrophysical and seismological methods of operative tsunami prediction.

3. Improve the communication channels used in the tsunami warning system and also to use special satellites.

4. Extend considerably the network of microbarographs and land base tide gauges.

5. Pursue and further develop the theory of tsunami generation and propagation.

6. Compile schemes of tsunami zoning in the Pacific and other coasts liable to inundation.

7. Carry out reasonable engineering protective measures in the populated localities and to exchange technical information during international symposia.

8. Improve public information and awareness of the tsunami threat.

9. Extend the activities of the IUGG tsunami committee, the ITIC, UNDRO and IOC.

10. Extend or create tsunami warning systems in all countries vulnerable to tsunamis."

The Chairman requested the Group to take these suggestions into account when considering the relevant parts of the agenda.

9. Proposals for Further Expansion of the Tsunami Warning System: The Director ITIC reported on liaison work by him and the Associate Director with member and non-member ICG/ITSU nations, and their efforts in coordinating the establishment of new seismograph and tide stations into the TWS and the upgrading of existing stations. Also, he reported on ITIC efforts in assisting IOC in inviting other countries to join ITSU and the TWS in the Pacific. He reported that Mexico was interested in joining. He also reported on the need for additional tide stations and on steps which were taken in expanding the TWS in the Bonin and other Pacific islands.

Subsequently, he presented a program development plan outline dealing with a three-phase automation and expansion of the Tsunami Warning System. The group agreed that a master plan be developed, and asked the Director to submit it, in first draft, to the next ITSU meeting.

10. Proposals for Further Improvements in Communication Including Standardization of Information Exchange and Dummy Tests: The Chairman brought to the attention of the Group the new manual printed by UNESCO-IOC on the Wave Reporting procedures for tide observers in the Tsunami Warning System. This manual, he reported, through ITIC coordination, was translated to Spanish by the Oceanographic Institute of Ecuador (INOCAR) and will be published by UNESCO-IOC in the near future.

INOCAR's support was greatfully acknowledged. The Group agreed that translation to other languages of the region is desirable and that such manuals improve considerably communications by standardizing the exchange of data for the Tsunami Warning System.

The Director ITIC presented for consideration three recommendations from his report dealing with methods of improving wave reporting procedures, extending the value of the dummy test in assessing the status of reporting stations, and on the use of geosynchronous orbit satellites for the Tsunami Warning System. Based on extensive discussions two recommendations were adopted (DR 9 and 10).

11. Proposal for a Pilot Project on Study of the Damage Caused by Tsunamis on the Western Coast of South America (UNESCO Doc. 18 C/5 par. 2395): A proposal from Peru, made to UNESCO's General Conference for a pilot project to study the damage caused by tsunamis on the Western Coast of South America was outlined in detail to the meeting by the Delegate from Peru.

The Secretary reported that the proposal had been approved by UNESCO, but that in order to implement it and have the use of the funds allocated, an action plan would have had to be submitted by late 1975. As a supplement he suggested that the representative from Peru, in consultation with Ecuador and Chile, draft a proposal and a plan for action with the assistance of Dr. G. Miller of the U.S. delegation and prepare a submission for UNEP funding. This was approved by the meeting, and appears as Recommendation DR 11.

A similar request was prepared for the Pacific island states. The plan of action is outlined in DR 8.

12. State of Preparation of Educational Material to Raise Public Awareness of the Danger of Tsunamis: The list of educational materials recommended for preparation by the Director ITIC, were reviewed and discussed by the Group. The value of several of these educational materials were recognized. The IOC proposed to support in its 1977 budget a catalogue of tsunami marigrams to be compliled by ITIC. DR 12 and 13 were adopted accordingly.

13. Election of a New Chairman: In accordance with the IOC rules of procedure, Mr. G. C. Dohler from Canada was elected new Chairman of the ICG/ITSU. As the present Vice-Chairman is Canadian, the Delegate of Canada offered to withdraw the incumbent Vice-Chairman from this post. The Group agreed on a necessary amendment to the agenda in order to make the election of a new Vice-Chairman possible. Mr. Cesar Vargas of Peru was elected new Vice-Chairman.

14. Date and Place of the 6th Session of ICG/ITSU: A formal offer of the Government of Chile was received to host the 6th Session of the ICG in their country. The Group appreciated this generous offer, but decided, however, for reasons of better geographical cover, to give preference to a meeting in one of the island states of the Western Pacific, as for example the Philippines. The Secretary of the IOC is requested to negotiate this matter further with the Philippines' Government.

15. Adoption of the Summary Report and Recommendations: The draft report of the meeting and the recommendations annexed to it, was adopted by the Group.

16. Closure of the Session: The Chairman thanked the Group and the staff provided by the Peruvian Government and by CERESIS for their excellent work and cooperation making the meeting a very successful one. He closed the meeting on Friday afternoon, 27 February 1976, at 5:00 pm.

RESOLUTIONS

DR 1: The ICG/ITSU recommends that member states supply to ITIC from all possible analogue tide gauge stations a record of recognizable tsunamis from a period 25 hours before the arrival of the initial waves to at least 25 hours after, or as long as the disturbance is visible, whichever is greater. The records may be submitted either as original diagrams for copying and return, or an accurate copy from which computer digitization is possible, or as a digital record, with all maxima, minima, and points of inflection.

The ICG/ITSU advises ITIC:

1. To solicit such material from all possible sources;

2. To publish for each Tsunami a listing of gauges for which the tsunami record is available, together with appropriate supplementary information; and

3. To arrange with WDC's for the storage and retrival of the tsunami data for the benefit of research.

DR 2: The ICG/ITSU, recognizing the need and desire of member states to establish regional and national tsunami warning systems, and automation of the Tsunami Warning System for the Pacific, and that the development of these systems will impose additional costs on ITIC, recommends that IOC invite its member states to make voluntary contributions, preferably on an annual basis, to the IOC Trust Fund, in order to support the staff and special projects at ITIC needed to develop these programs.

DR 3: The ICG/ITSU recommends

that Member States make voluntary contributions to the IOC Trust Fund to enable individual scientists and technicians from those countries to receive training at ITIC, Honolulu,

and also recommends that

agencies in these countries consider sending scientists and technicians at their own expense in order to enable them to receive specialized training with new instrumentation, techniques and civil preparedness procedures.

DR 4: The International Coordinating Group of ITSU, noting with approval the accomplishments of the ITIC reported at this meeting; and noting especially the dynamic, forceful leadership of the Director and Associate Director in the past year, on behalf of all member states;

highly commends the Director and Associate Director for their joint efforts; and further

commends their national sponsors, the governments of the United States and Canada, for the assignment of these scientists to serve the international community concerned about the dangers of tsunamis.

DR 5: The International Coordinating Group of ITSU, having previously noted the accomplishments of the Associate Director in his first year of service at ITIC,

requests the Government of Canada to consider extending the service of the incumbent, Mr. Sydney Wigen, as appropriate to the tasks at hand.

DR 6: The ICG/ITSU

still unsatisfied with the revision of the functions of the ITIC, as adopted by the IOC Executive Council at its 6th Session,

recommends

that the IOC Secretary together with the Director of ITIC and the relevant U.S. authorities, develop a clear mandate for the ITIC, particularly its functions, taking into account that ITIC should further develop toward an independent international body under the authority of the IOC,

and that

the Secretary submit this new mandate in writing to the Member States of ITSU, before February 1977, for adoption.

DR 7: The International Coordinating Group of ITSU-V

recommends that each member-state participating in the Tsunami Warning System, including those interested in tsunami phenomena, prepare and submit to ITIC, a report on research, preferably on an annual basis. This report should include a bibliography and abstracts of both published and unpublished research.

DR 8: The ICG/ITSU recommends

that taking into account the growing UN concern with the negative effects of natural disasters on developing island countries as reflected by the general assembly resolution 3202 (S-VI) and resolution 108 (XV) of UNCTAD on (amongst others) assistance in developing island countries to overcome the effects of natural disasters,

UNESCO, its IOC and ITIC should encourage and assist island states members of ITSU, on building up their scientific and technical infrastructure for the purpose of developing regional or national projects related to natural disaster and tsunami warning systems, research and training, and those not yet being ITSU members to become members of the International Warning System and its coordination group.

In order to bring this into effect it is further recommended that IOC seek funding from UNEP to carry out the following three stage action program on planning of early warning and preparedness, to be implemented through ITIC:

1. Director or Associate Director to make a liaison and familiarization visit to each of the developing island countries expressing interest in such a visit, in the south and southwest Pacific. Primary purposes of the visit will be to establish working contacts, bring awareness of the services ITIC can provide in developing plans and organization for national or regional Tsunami Warning Systems, and to gain insight in the Tsunami hazards of each of these states, and potential needs and available resources to alleviate the hazards.

2. To convene a workshop in Honolulu,in each of the two regions (Indonesia, Philippines on one side, Pacific small island states on the other), to plan a programme of action for regional and national tsunami warning systems including technical problems of tide and seismic sensing, communications and civil preparedness.

3. To conduct a technical workshop and seminar in Honolulu with assistance of local tsunami, seismic, communication, and civil preparedness specialists for experts from the interested states.

4. In addition to travel expenses for the above three projects, some part time secretarial assistance will be required.

The program is to be completed preferably prior to 6th Session of the ICG/ITSU.

DR 9: The ICG/ITSU recommends

that ITIC should inform tide stations of the TWS biannually on recommended format for reporting the initial amplitude and subsequent maximum wave heights at regular intervals following a tsunami arrival,

and also recommends that

the scope of the tsunami dummy test should be expanded to include a report on the condition of the stations, and reporting the tide height at the time of the test, which subsequently can be verified from tide tables.

DR 10: The ICG/ITSU recommends

that use of the Geostationary Orbital Environmental Satellite (GOES) system to be considered essential for rapid data acquisition and dissemination of Tsunami watches, warnings and both seismic and tidal information.

The U.S. has placed a GOES satellite positioned at 135° W Longitude. However, the area of the Philippine Sea, Japan, Kuril Island, Kamchatka, Indonesia, Papua-New Guinea and the Solomon Sea still remain out of communications range.

The ICG/ITSU therefore further recommends

that the Secretary, IOC explore the availability of other geosynchronous satellites and that countries planning to launch similar satellites give consideration to compatibility of communication codes and instrumentation for possible participation in the TWS.

DR 11: The ICG/ITSU,

noting that the 18th General Conference of UNESCO approved a pilot study of tsunami effects on the west coast of South America, as proposed by the Delegation of Peru, and bearing in mind UNEP's interest in early warning planning and preparedness,

recommends

that a pilot study be carried out to predict the potential tsunami hazard and produce corresponding inundation maps which will be used for development planning and risk zoning for Civil Defense purposes.

Further recommends

that IOC seek funding from UNEP to carry out the following action program:

1. A four-week workshop coordinated by ITIC in Honolulu, attended by an expert designated from each of the four participating countries (Colombia, Chile, Ecuador and Peru), to process the necessary basic input data using state of the art computer programs. Each participant will select the area to be thus studied in accordance with his own country interests.

The workshop will involve the discussion of the physical aspects of the problem and an understanding of the corresponding computer programs, (with the participation of Hawaii Institute of Geophysics experts). Funds required for travel and per diem US $11,000; funds required for computer time at HIG US $1,000.

2. Each country will apply the results of the workshop and produce a tsunami risk map and the report, for a priority area of their own interest. Funds required for computer time US $4,000.

The program is to be completed within six months after funds are made available.

Total request for funds: US $16,000.

DR 12: Recommendation on Training

The ICG/ITSU recommends that

ITIC coordinate the exchange of scientific and technical personnel between ITSU member states, for the purpose of providing training and familiarization with automation equipment, new instrumentation, and new methods and procedures of the Tsunami Warning System and of Civil Defense.

DR 13: The ICG/ITSU recommends that UNESCO, IOC and national and international agencies provide support for the following educational materials related to tsunamis and that the preparation of these materials be coordinated by ITIC:

1. Preparation and publication of the final version of the "Catalog of Tsunamis in the Pacific Ocean" by Iida, Cox, Soloviev and Pararas-Carayannis. Material to be compiled at ITIC, updating, expanding and correcting the preliminary catalog.

2. With support from IOC, preparation and publication in the languages of the region of an expanded version of the IOC tsunami brochure (prospectus) which would help arouse public awareness of the danger of tsunamis, and also the protective action that should be taken upon receipt of a tsunami warning.

3. Preparation and publication of an updated annotated bibliography of tsunami publications for use by the scientific community, Civil Defense Agencies, libraries and the general public. (The last bibliography was published in 1964.)

4. Preparation and publication of an illustrated semi-technical text book on tsunamis, presenting selected papers on tsunami origin, propagation, and run-up, on the regional and Pacific tsunami warning systems, and on the sociological aspects of tsunamis.

5. Compilation of a catalogue of tsunami marigrams for historic tsunamis recorded at selected gauging stations throughout the Pacific, for publication by UNESCO.

6. Translation of the manual on Wave Reporting Procedures into other languages of the region, and publication.

7. Compilation from different countries of existing films and miscellaneous footage on actual or simulated tsunamis to serve as a data basis for researchers

and as a viewing aid in presenting information on tsunamis to the general public.

8. Preparation of an educational film on the tsunamis, tsunami effects and on the International Tsunami Warning System for distribution to interested countries.

9. Creation of a photographic file at ITIC and the compilation into a report of collected photographs of tsunami waves and their effects.

10. Preparation of a series of narrated tsunami slide presentations on the Pacific Warning System, on the Honolulu Observatory, on ITIC, and on community preparedness.

11. Preparation and publication of a bibliography on engineering studies relative to tsunami problems for specific shore-line projects.

12. Preparation and publication of a Directory of tsunami scientists.

13. Preparation and publication of manual establishing a methodology for estimating tsunami inundation.

14. Preparation and publication of tsunami travel time charts for new tide stations.

15. Preparation and publication of seismic wave travel time charts for expedient earthquake epicenter determination.

NEWS EVENTS

Tonga-Samoa Islands Earthquake, 26 December 1975

On December 26, 1975, a major earthquake of magnitude 7.2 occurred in the Tonga Trench about 200 miles south of American Samoa. (This event occurred just before press time of our last Newsletter, and we were not able to fully report on its effect). The magnitude and origin of this earthquake prompted ITIC's Honolulu Observatory to issue a tsunami watch. Reports from Apia, Western Samoa, and Pago Pago, American Samoa, indicated that a minor tsunami of 35 cm. and 75 cm., respectively, had been recorded. Tsunami stations at Suva, Fiji and Canton Island, reported no unusual wave activity. From these reports, Honolulu Observatory concluded no Pacific-wide tsunami had been generated and cancelled its earlier posted watch.

An interesting follow-up account was reported in the Pago Pago, American Samoa News Bulletin, on December 29, regarding this earthquake. It was reported in this bulletin:

"The temblor started just a few minutes before 5 a.m. and lasted about 30 seconds -- although it seemed much longer. It began with a shaking of the ground, then a couple of minor jolts, some stronger trembling and another jolt."

"At 6:30 a.m., 90 minutes after the quake, ITIC's Honolulu Observatory, in Hawaii reported that a tsunami watch has been issued in the Pacific because of a "strong

earthquake in the Tonga Islands." Scientists gave a preliminary reading of 7.2 on the Richter scale and were working to determine whether or not a wave had been generated."

"At 8:30 a.m., the tsunami watch was cancelled because only "very minor" wave action was reported at Pago Pago, Apia, Suva and Canton Island."

Kermadec Ridge Earthquakes, 14 January 1976

On January 14, 1976, two major earthquakes occurred within an hour's time near Raoul Island in the Kermadec Islands region of the South Pacific Ocean. (An earthquake of magnitude 6.5 was also recorded in this immediate vicinity on January 1, 1976.) The earthquakes apparently caused no damage or injuries in the Kermadec Islands, a group of five sparsely populated islands 600 miles north of New Zealand.

The first quake of magnitude 7.3 prompted Honolulu Observatory to issue a press release. The following quake of magnitude 7.6 was definitely tsunamigenic, and Honolulu Observatory issued a Tsunami Watch. Tide stations queried following this earthquake were, Suva, Pago Pago, Apia, and Marsden Point. Pago Pago and Apia reported only a negligible disturbance. These negligible tsunami reports prompted H.O. to cancel its earlier posted tsunami watch. It was later reported by the Australian Domestic Service that a 90 cm tsunami reached southern Fiji.

Kuril Trench Earthquake, 21 January 1976

A strong earthquake of magnitude 7.3 occurred in the North Pacific Ocean, approximately 400 km east of Hokkaido, Japan, in the Kuril Trench, on January 21, 1976. ITIC's Honolulu Observatory issued a press release for this event as no Pacific wide tsunami was generated. The ITIC is presently awaiting reports from the USSR tsunami center at Sakhalin, and from the Japan Meteorological Administration if there was, in fact, a local tsunami recorded in their immediate area.

The National Earthquake Information Service reported that the earthquake was felt in Hokkaido.

Guatemala Earthquake, 4 February 1976

The disastrous magnitude 7.5 earthquake that rocked Guatemala City, Guatemala, during the early morning hours of February 4, and left thousands dead or injured, did not generate a tsunami, either locally or Pacific wide. Negative wave reports were received by Honolulu Observatory from both Baltra Island, Ecuador, and Acajutla, El Salvador, which were queried after the earthquake.

The following account of the Guatemala Earthquake appeared in the event information reports of the Center for Short-Lived Phenomena:

The epicenter of the 4 February 1976 earthquake was 160 km NE of Guatemala City on the Motagua Fault, which runs ENE across nearly 300 km of southern Guatemala from the Sierra Madre to the Gulf of Honduras. The fault appears to be a landward continuation of the 6300-meter-deep Cayman Trench in the Caribbean Sea. The Motagua Fault-Cayman Trench system marks the boundary between the North American Plate to the NW

and the Caribbean Plate to the SE. At its western end, the fault intersects the Sierra Madre, a mountain range running NW to SE and marking the circum-Pacific subduction zone in Guatemala.

According to the US Geological Survey, the movement associated with the earthquake was almost entirely left-lateral strike-slip, indicating that the North American Plate moved southwestward relative to the Caribbean Plate. Lateral displacement has been observed at fence lines and roads along the fault. During USGS overflights, surface faulting was observed beginning approximately 20 km north of Guatemala City and extending 175 km NE along the Motagua Fault. A geological team from the Instituto Geografico Nacional, the USGS, and the State University of New York at Binghamton, New York, has mapped a 200-km-long fault zone, 2 to 5 meters in width, striking 60° to 75° east of north, with en echelon fractures striking 40° to 50° east of north. The maximum lateral displacement measured during preliminary ground surveys was 1.2 meters. USGS researchers believe that surface faulting occurred in the mountainous region west of Guatemala City, but the ruggedness of the terrain has so far precluded detailed investigation. Based on the extent of surface fissuring, the USGS has estimated a focal depth of only 5 to 10 km for the quake.

As of 16 February, over 900 aftershocks had been recorded by the National Observatory in Guatemala City. Two weeks after the quake, aftershocks had decreased in frequency to about 30 per day. The National Earthquake Information Service has reported four major aftershocks: 5.75 to 6.0 MS at 181916 UTC on 6 February; 5.5 MS at 081348 UTC on 8 February; 5.5 MS at 114445 UTC on 9 February; and 4.7 MS at 061807 UTC on 10 February. The epicenters of the major aftershocks have been widely dispersed along the Motagua Fault, at distances of up to 160 km from the epicenter of the 4 February earthquake. The epicenter of the 6 February aftershock appears to have been close to the Volcan de Pacaya, SW of Guatemala City. According to unconfirmed reports, swarms of minor aftershocks have originated in the vicinity of Pacaya. There are also reports that Pacaya and other volcanoes in the Sierra Madre were active shortly before and after the earthquake.

The Guatemalan Earthquake, the worst earthquake disaster in Central America this century, caused significant damage in areas northeast and northwest of Guatemala City, as well as in Guatemala City itself. The damaged region comprises approximately 9065 square kilometers of Guatemala. Preliminary damage estimates have ranged from 4.5 to 6 billion dollars. As of 18 February, the Government of Guatemala reported 22,400 dead, 74,600 injured, and more than one million (about twenty per cent of the total Guatemalan population) homeless. The most severely affected area was the Department of Chimaltenango in the Sierra Madre northwest of Guatemala City. In Chimaltenango, many towns were completely destroyed, and, out of a total population of 197,000 people, 13,480 were killed and 171,000 were left homeless.

Millions of dollars in aid have poured into Guatemala from government and private agencies in more than twenty-five countries. The initial concern was to provide earthquake victims with food, potable water, emergency medical care, and shelter. Due to disruptions in transportation and communications, relief workers were unable to contact the more remote villages for several days following the quake. Helicopters were used to airlift supplies and medical teams to rural areas and to evacuate the injured to hospitals. About ten days after the quake, relief agencies announced that Guatemala had received enough food and medical supplies to meet its disaster emergency, and, in Guatemala City and many other devastated communities, relief efforts began to focus on rehabilitation and reconstruction. Many of the damaged structures were tile-roofed adobe huts, a common form of housing in Guatemala. Officials have considered using

corrugated aluminum roofs and concrete support columns to make the huts more earthquake-resistant.

Landslides resulting from the earthquakes have blocked roads and railroads throughout the damaged region. In Chimaltenango, two major landslides have dammed rivers near Patzun and San Martin Jilotepeque, and small lakes have formed behind the dams. According to reports, the dam near San Martin Jilotepeque is 60 meters high. Officials fear that, during the rainy season in May, the dams might collapse, causing flooding in communities downstream. Local groups have begun to dig channels to drain the backed-up water.

REPORTS FROM INTERNATIONAL TSUNAMI INFORMATION CENTER - HONOLULU

Acknowledgement

We would like to, again, express our appreciation to those individuals and authorities who are continuing to support ITIC's ongoing program for the systematic collection of tsunami data. This information will permit ITIC to determine tsunami travel times as well as tsunami hazards for specific areas.

Specifically, we have received excellent support from the tidal authorities in Australia, Papua-New Guinea, New Zealand, Western Samoa, Japan, and Fiji. ITIC will appreciate receiving analog tidal records of tsunamis from gaging authorities in all countries, whether a specific request has been formally submitted or not.

INOCAR Provides ITIC with Spanish Translation of Wave Reporting Manual

Capitan Pedro Cabezas Gonzales, Director of Ecuador's Instituto Oceanografico de la Armada (INOCAR), and his staff, have kindly provided ITIC with a Spanish translation of the manuscript "Wave Reporting Procedures for the Tide Observers in the Tsunami Warning System." This report in Spanish will be published by UNESCO-Intergovernmental Oceanographic Commission (IOC) in the near future. IOC has already published an English version.

INOCAR, by translating this report, is greatly contributing to the effectiveness of the International Tsunami Warning System. Ecuador's continuing support of the International Tsunami Warning System is appreciated.

ITIC will make draft copies of this translation available, upon request, until UNESCO-IOC prints the final version.

Philippine Survey Director Visits ITIC and the Honolulu Observatory

Commodore Jayme V. Presbitero, Director, Philippine Bureau of Coast and Geodetic Survey, visited ITIC's Honolulu Observatory on March 4, 1976, enroute to the Philippines from the recently held ITSU meeting in Lima, Peru. Commodore Presbitero also conferred with Dr. George Pararas-Carayannis while in Honolulu, regarding the development of a regional Philippine Tsunami Warning System. The Philippines may be eligible for assistance in establishing a regional tsunami warning system under the United Nations assistance plan for developing countries.

Director and Associate Director, ITIC, Visit South and Central American Countries

Dr. George Pararas-Carayannis, Director ITIC, following the ICG/ITSU meeting in Peru, visited officials in Colombia for the purpose of discussing Colombia's participation into the International Tsunami Warning System and the proposed Regional South American Warning System.

Mr. Sydney O. Wigen, Associate Director of ITIC, is presently touring several Central American countries, to establish liaison contacts for ITIC and inform interested parties of the International Tsunami Warning System.

Mr. Wigen departed Lima, Peru, after attending the recent ITSU meeting, for Panama, Costa Rica, Nicaragua, El Salvador, Guatemala, and Mexico. After his visit in Mexico, Mr. Wigen plans to visit Victoria, Canada before returning to ITIC in Honolulu.

Trip reports on these visits will appear in the next issue of the ITIC Newsletter.

TSUNAMI WARNING SYSTEM IN THE PACIFIC

Tsunami Station Visitation and Inspection

During the months of December 1975, and January 1976, Mr. Mickey Moss and LTJG Garth Stroble, of the National Ocean Survey's Pacific Tide Party, and LTJG Dennis Sigrist, Assistant Tsunami Specialist of the U.S. National Weather Service, Pacific Region, inspected various domestic and foreign tsunami tide stations in the Central Pacific. Apia, Western Samoa; Suva, Fiji; White Beach, Okinawa; and the Tsut Territory of the Pacific were included in these inspection visits this year in addition to the U.S. operated stations on many remote islands.

These inspection visits of the tsunami tide gauge stations in the Pacific provide routine maintenance of the equipment and thorough instruction of personnel on wave reporting procedures. Inspection visits of this nature are performed yearly.

SMS/GOES Deployments Complete

GOES-1, the National Weather Service's Synchronous Meteorological Satellite, which was successfully launched last fall, became operational on January 8, 1976. SMS-I, which has been replaced by GOES-1, has been moved to about 105°W and is now in a standby status. SMS-2, the vital communications link in the proposed automated Tsunami Warning System, began a westward movement of 2° per day on December 9. SMS-2 arrived on station near 135°W on December 19, its present position. This further westerly position of SMS-2 will permit increased visual and communications coverage of the Western Pacific while maintaining adequate communications coverage of the western coasts of North and South America.

Tsunami Tide System Communicates via Satellite

Dr. Harold Clark, Chief Engineer of the Albuquerque Seismological Laboratory of the U.S. Geological Survey, Albuquerque, New Mexico, informed ITIC that the Laboratory

has just successfully completed the installation and testing of the advanced Tsunami Tide System in San Diego, California. This Tsunami Tide System is in communication with Suitland, Maryland via NOAA's SMS-2 satellite. In addition, the System can be nterrogated on command via this satellite from the facilities in Suitland.

The Tsunami Seismic System is also operating over the SMS-2 satellite in a similar manner but is located at the Albuquerque Seismological Laboratory. Albuquerque is presently working on methods and techniques to greatly reduce the cost of the Tsunami Systems and the GOES/SMS radios by using new low cost microprocessors.

Dr. Gaylord Miller, of NOAA's JTRE at the University of Hawaii, will be experimenting with one of the GOES/SMS satellite radio transmitters in Hawaii.

Satellite System will Warn of Tsunamis

The U.S. National Oceanic and Atmospheric Administration (NOAA) recently awarded a half million dollar contract to Systems Division of GTE Information Systems, Silver Spring, Maryland, for fabrication of a system communicating early indication of potentially disastrous natural phenomena such as tsunamis, flooding, earthquakes, and the like.

The Tsunami Warning System in the Pacific presently depends heavily upon existing telephone and telegraph lines for transmission of seismic and tidal data. Eventually, these data will originate from remote sensing platforms, presently under development by the U.S. Geological Survey's Albuquerque Seismological Laboratory.

new communications system, made available by the development of NOAA's environmental satellite program, will enable the critical information recorded by the sensing platforms to be flashed almost instantaneously to those responsible for alerting the public of an impending potential disaster.

The system calls for design and fabrication of a computer system and a communications network to transmit sensing platform data in real time to such data users as the U.S. National Weather Service, the National Data Buoy Office, the U.S. Geological Survey, the International Tsunami Warning System, and others.

NOAA's geostationary satellites - GOES I, watching the East Coast, and SMS-II, watching the Pacific Coast and Hawaii - each have the capacity of monitoring a minimum of 10,000 data collection platforms within any six-hour period.

NOS Standard Tide Gages to be Phased Out

The Pacific Tide Party of NOAA's National Ocean Survey will be slowly phasing out the now obsolete C&GS standard tide gage, presently in use throughout the Pacific. NOS reports that it is now almost impossible to maintain these gages due to the fact that new parts are unobtainable, specifically new clock-chart drive components.

The U.S. National Ocean Survey has been maintaining these gages so as to provide the Tsunami Warning System with an analog trace of any tsunami which may occur in the Pacific Ocean. Presently, the NOS uses the ADR, analog to digital recorder, to obtain tidal data, and they now have no requirement for the analog trace provided by

the standard gage. The Tsunami Warning System's remote recording tide unit, located at many Pacific station installations, will continue to operate and provide analog tidal data in the event that a tsunami occurs.

In-situ Tsunami Pressure Sensor Detection System

A proposal has been submitted by Aanderaa Instruments, Norway, concerning an In-situ Tsunami Pressure Sensor Detection System.

The tsunami detection system can be constructed using the Aanderaa Water Level Gauge, a modest and economical computing system, and a suitable network of interface circuitry using the full facilities of the standard voice grade telephone lines.

A typical detection station consists of an Aanderaa Water Level Gauge connected via a submerged cable (or hydrophone and Radio Frequency link) to the shore station. This station supplies the interface to the telephone lines plus support functions to the central collection agency and the water level gauge.

The tide height data may be stored permanently on magnetic tape in the gauge and/or temporarily at the station site. The central collection agency has access to a grid of such systems. It has the ability to draw upon the temporary data stored in the station plus control over the sampling rate of each gauge. Control of the systems is via a 32K core minicomputing system with individual station identification stored on disc. Permanent records can be made on 1/2", 9 track IBM magnetic tape. Operation and status is accomplished by CRT display and keyboard.

Although more sophisticated communication channels exist (eg. satellite transmission), it is felt that the proposed Aanderaa system has the advantages of low initial set up costs allowing immediate evaluation of a grid system of Aanderaa tide gauges to study of tsunamis without massive initial expenditure. It also has the extra advantages of two way communication with the monitoring station (ie. in-situ tide gauge), and, if desirable, it permits multiuser access to the data. Finally, the basic system contains all the hardware necessary for a satellite communication system should such be desirable in the future.

NATIONAL AND AREA REPORTS

Tsunami Evacuation Plan for Hawaii

Hawaii State Civil Defense officials will now call for the immediate evacuation of the population from low-lying areas in the event of any locally occurring earthquake that has a magnitude greater than 6.5.

This new policy means that Civil Defense officials will not await epicenter determinations from either ITIC's Honolulu Observatory (HO), or Hawaii Volcano Observatory (HVO) but make their evaluation of magnitude from strong motion seismic alarms being installed throughout the State in conjunction with data received from HO and HVO.

It was apparent from the local earthquake and tsunami of November 29, 1975, on the Island of Hawaii, that it is difficult, if not impossible, to determine quickly whether a local quake is tsunamigenic or not.

A Wave Forecasting Technique

Dr. Gaylord Miller, Director of NOAA's Joint Tsunami Research Effort (JTRE), has kindly provided ITIC with information on wave sensors and forecasting techniques:

A wave measurement system was recently put into operation at Mokuleia, on the North Shore of Oahu, Hawaii. Through the use of such a system it is possible to make a very good wave forecast for waves which originate from a storm which is at least two thousand kilometers distant. This wave reporting system, which was built under the direction of Dr. Martin Vitousek of the University of Hawaii (with the assistance of the Joint Tsunami Research Effort and the National Weather Service), transmits pressure data from the sea floor to a recording system at the University and to a display at the Honolulu Airport. Thus, statements about the measured wave height can be included in weather service broadcasts, and an accurate record of the wave climate may be obtained for future reference. Such wave climate data is very useful in establishing design criteria for coastal structures which may be built in the future. Using data from such a gage system it is also possible to make a very accurate wave forecast.

The wave recording system will permit a quantitative statement to be made about the height of the waves in the normal weather report. For storms that are somewhat distant, a wave prediction can be made from the wave record itself. Wave climate data will be gathered so that future coastal structures can be designed with a good knowledge of the actual wave conditions in mind.

ABSTRACTS AND RESUMES

The Tsunami of November 29, 1975 in Hawaii

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NOAA-JTRE-152, HIG-75-21

Abstract

Wave runup heights for the tsunami of November 29, 1975, are reported for locations on the Island of Hawaii.

Normal Modes of Oscillation of Honokohau Harbor, Hawaii

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NOAA-JTRE-142, HIG-75-20

Resonances in Honokohau Harbor, located on the west coast of the Island of Hawaii, near Kailua-Kona town, is studied with numerical modeling.

Linearized Long Wave, Numerical Model of the Hawaiian Islands

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and
University of Hawaii
Honolulu, Hawaii 96822

NOAA-JTRE-136, HIG-75-13

Abstract

A numerical model simulating linearized long waves interacting with the seven major Hawaiian Islands is presented. A spline interpolation scheme is utilized to convert the actual soundings of the island bathymetry to a 5.5-km-square grid closely approximately the topography of the islands. A time marching, central difference, explicit scheme is used to evaluate the wave field by the linear, Eulerian equations of motion and continuity in Cartesian coordinates for a frictionless homogeneous fluid. The condition of nonnormal flow is employed at the island shorelines and a localized interpolation technique is utilized at the outer boundary to simulate a free-flow boundary. Verification of the numerical procedure is accomplished by agreement with analytic solutions of steady-state problems involving wave interaction with geometric islands in both constant and variable depth cases. A test run from the north is illustrated and selected wave records are shown.

ANNOUNCEMENTS

First General Assembly - Association of Geoscientists for International Development

The Association of Geoscientists for International Development (AGID) will hold its first General Assembly and Symposia on Natural Resource Management in Developing Countries in Sydney, Australia, 15-22 August 1976.

The Association of Geoscientists for International Development (AGID) is an international, non-profit and non-governmental organization. It consists of over 400 individual members and some 25 supporting members representing academic institutions, mining companies, multilateral and governmental agencies.

The first General Assembly of AGID will be held in Sydney, on Sunday, August 15, 1976, immediately prior to the opening of the 25th International Geological Congress.

Further information regarding the AGID meetings can be obtained from the Secretary-Treasurer, Dr. A. R. Berger, Department of Geology, Memorial University, St. John's, Newfoundland, Canada, or from the Chairman of the AGID Sydney Committee, Dr. M. B. Katz School of Applied Geology, University of New South Wales, Kensington, N.S.W. 2033, Australia.

International Geological Congress

The XXV Session of the International Geological Congress will be held in Sydney, stralia from the 16th to the 25th of August, 1976.

Information on the International Geological Congress may be obtained from the Secretary-General, 25th International Geological Congress, P.O. Box 1892, Canberra City, A.C.T. 2601, Australia.

CERC Coastal Water Level Prediction Course

The Department of the Army's Coastal Engineering Research Center will be sponsoring a closed session, limited attendance, course from March 30, 1976 through April 2, 1976, inclusive, at the South Pacific Division of the U.S. Army, Corps of Engineers Conference Room, San Francisco. Dr. George Pararas-Carayannis, Director, ITIC, has been invited to participate in this course, as a lecturer, talking on historical Pacific tsunamis and the International Tsunami Warning System. This course is being supported by OCE, Office of the Chief of Engineers, U.S. Army, and attendance will be limited to invited government individuals.

Decision Making for Natural Hazards

A conference sponsored by the Engineering Foundation Conferences to be held at Asilomar Conference Grounds, Pacific Grove, California, USA during the week of March 21, 1976.

e following tentative program has been received by ITIC:

March 21 Registration and Check-in

March 22 Natural Hazards - Severity, Geographic Distribution, Frequency of Occurrence

March 23 Disaster Mitigation and Insurance

March 24 Finance and Risk Analysis

March 25 Cost Effectiveness and Formal Warning Systems

March 26 Decision Making

Geodetic Measurements in the Ocean

June 28-30, 1976, Urbana, Illinois, University of Illinois at Urbana-Champaign.

The conference program, as announced in the September and December issues of the ITIC Newsletter, and the final list of participants for the panel discussion on tsunamis has been tentatively arranged. Those who have been sent official invitations for the discussions on tsunamis are:

Mr. G. C. Dohler
Canadian Hydrographic Service

Topic: International tsunami coordinating group, its achievements, goals and objectives in the detection and real-time data transmission of tsunami information.

Prof. C. O. Hines
Department of Physics
University of Toronto

Topic: Proposal for ionospheric detection of tsunamis.

Dr. G. R. Miller
Director
Joint Tsunami Research Effort

Topic: Real-time deep ocean measurements of tsunamis.

Dr. G. Pararas-Carayannis
Director
International Tsunami Information Center

Topic: A new operational concept for the International Tsunami Warning System.

Mr. M. Spaeth
National Weather Service

Topic: Operational aspects of the tsunami warning service in the Pacific.

15th International Conference on Coastal Engineering (COASTAL-76) at Honolulu, Hawaii

Will be held 11-17 July 1976 at the Hilton Hawaiian Village (a hotel on the beach at Waikiki) as sponsored by the American Society of Civil Engineers and the State of Hawaii. Approximately 280 papers will be presented including those on: wind generated waves; tsunami; storm surge; seiching; sediment behavior; estuary behavior; environmental impact of coastal works; dispersion; coastal structures; coastal morphology; miscellaneous (odors, earthquakes, charts, management).

Registration fee: Participants $75; spouse $35. Checks payable to "University of Hawaii Conference Center." For more information on registration and accommodations write to: University of Hawaii Conference Center, 2500 Dole Street; Honolulu, Hawaii 96822. (The American Shore and Beach Preservation Association will hold its annual technical meeting 13 and 14 July 1976 at the same hotel and will also assist COASTAL-76.)

The following papers have been accepted for the Tsunami Session, as reported in the December 1975 ITIC Newsletter:

21 Tsunami Generation on a Continental Shelf
Basil W. Wilson; Consulting Oceanographic Engineer
Pasedena, California USA

34 Assessment of the Potential Tsunami Hazard in Planning and Designing Coastal Structures
George Pararas-Carayannis; International Tsunami Information Center
Honolulu, Hawaii

38 Calculations of Waves Formed from Ocean Surface Cavities
Charles Mader; University of California, New Mexico USA

39 Three-Dimensional Hydraulic Model Study of Water Waves Generated by Horizontal Tectonic Displacements
S. H. Liu & R. Wiegel; University of California, Berkeley USA

116 Wave Amplitudes Along the Pacific Coast of the Continental US Due to Tsunamis Originating in the Peru-Chile Trench
Mr. A. W. Garcia & Mr. H. L. Butler; Wave Dynamics Division Hydraulics Lab. U.S. Army Engineers Watersways Experiment Station
Vicksburg, Mississippi USA

177 Transformation of Tsunamis in a Coastal Zone
Dr. Shigehisa Nakamura; Disaster Prevention Research Institute
Kyoto University, Uji, Kyoto 611
Japan

198 A Reasonably Practical Real-Time Tsunami Preduction Scheme
Dr. Harold G. Loomis; Joint Tsunami Research Effort
NOAA, University of Hawaii USA

199 Tsunami of October 3, 1974 on the Coast of Peru
Ing. Cesar Vargas Faucheux; Direccion de Hidrografia y Navegacion de la Marina
La Punta, Callao, Peru

206 Numerical Models of Tsunamis Caused by Huge Earthquakes off the Sanriku Coast
Professor Toshio Iwasaki; Faculty of Engineering
Tohoku University, Sendai
Japan

227 Tsunami Propagation in the Pacific Ocean: Computations with a Hydrodynamical Numerical 1^{o}-World Ocean Model
Dr. Manfred Engel & Dr. Wilfried Zahel; Department of Oceanography
University of Hamburg
Institut fur Meereskunde
W. Germany

279 Cooperative Union of Soviet Socialist Republics and US of America Tsunami Experiment
Dr. Robert R. Harvey & Dr. Gaylord R. Miller; Joint Tsunami Research Effort
NOAA, University of Hawaii
Honolulu, Hawaii USA

326 Conditional Expected Tsunami Inundation for Hawaii Using Output of Bernard's Model for Terminal Response
Dr. Wm. Mansfield Adams; Department of Geophysics
University of Hawaii
Honolulu, Hawaii USA

388 Computation of Scattering of Tsunamis Attacking an Island
Dr. Ivar G. Johnsson, Dr. Ove Skovgaard & Mr. Ole Brink-Kjaer
Institute of Hydrodynamic and Hydraulic Engineering
Building 115B
Tech. University of Denmark
DK-2800 Lyngby, Denmark

412 Tsunami Inundation Prediction
Dr. Charles L. Bretschneider & Mr. Pieter G. Wybro
Department of Ocean Engineering
University of Hawaii
Honolulu, Hawaii USA

440 A Study of Tsunami Generated by the Izu-Hanto-Oki Earthquake of 1974
Mr. Yoshinobu Tsuji
National Research Center for Disaster
Prevention, Japan

HONOLULU OBSERVATORY REPORTS

Summary of 1975 Tsunami Investigations by ITIC's Honolulu Observatory

Date and Origin Time (GMT)	Epicenter	Magnitude	Region	Comments
Feb 2 0843	53.5 N 1.73E	7.3-7.5	Near Is., Aleutians	Damage at Shemya No wave action
Feb 4 1136	40.8 N 122 E	7.3	Eastern China	
Feb 22 0836	51.5 N 179.1 W	6.6	Adak, Alaska	
Mar 13 1527	26.0 S 75.0 W	6.7	Northern Chile	
Mar 13 1845	21.5 S 171 E	6.8	Loyalty Islands	
May 10 1429	35.7 S 74.6 W	7.8	Chile	Tsunami Watch

Date and Origin Time (GMT)	Epicenter	Magnitude	Region	Comments
Jun 10 1347	42.9 N 147.6 E	7.2	Hokkaido, Japan	Small local tsunami
Jun 13 1808	43.5 N 148.2 E	6.6	Hokkaido, Japan	
Jul 8 0937	29.3 N 113 W	6.7	Gulf of California	
Jul 10 1829	7 N 126 E	7.1	Mindanao, Philippines	
Jul 20 1437	6.5 S 154.9 E	7.7	Solomon Sea	Tsunami Watch
Jul 20 1954	6.9 S 155.5 E	7.3	Solomon Sea	
Jul 21 0239	6.6 S 154.9 E	6.7	Solomon Sea	
Oct 1 0330	4.9 S 101.6 E	6.9	Sumutra	Press Release
Oct 6 2224	12.5 S 166.7 E	7.0	New Hebrides	Press Release
Oct 11 1435	25.3 S 174.9 W	7.3	Tonga Is.	Press Release
Oct 31 0830	13.0 N 126.2 E	7.4	Philippine Is.	Press Release
Nov 29 1448	19.4 N 155.1 W	7.2	Hawaii	Local Warning
Dec 26 1556	15.5 S 172.0 W	7.2	Tonga Trench	Watch Issued

Seismic Summary (January 1, 1976 to Press Time)

Date and Origin Time (UTC)	Epicenter	Magnitude	Region	Comments
Jan 1 0129Z	29.0 S 178.0 W	6.5	Kermadec Islands	Press Release
Jan 14 1546Z	25.6 S 177.8 W	7.3	Kermadec Island Area	Press Release

Date and Origin Time (UTC)	Epicenter	Magnitude	Region	Comments
Jan 14 1647Z	29.0 S 178.0 W	7.6	Kermadec Island Area	Watch Issued
Jan 15 2757Z	Island of Hawaii	5.5	Island of Hawaii	Press Release
Jan 21 1005Z	46.5 N 147.3 E	7.3	Kuril Islands	Press Release
Feb 4 0901Z	15.6 N 89.1 W	7.5	Guatemala	Press Release
Mar 4 0250Z	15.2 S 167.0 E	7.0	New Hebrides	Press Release